Easidew Plus
Portable Hygrometer
User's Manual

KAHN

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Easidew Plus Portable Hygrometer

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Safety

The manufacturer has designed this equipment to be safe when operated using the procedures detailed in this manual. The user must not use this equipment for any other purpose than that stated. Do not apply values greater than the maximum value stated.

This manual contains operating and safety instructions, which must be followed to insure the safe operation and to maintain the equipment in a safe condition. The safety instructions are either warnings or cautions issued to protect the user and the equipment from injury or damage. Use qualified personnel and good engineering practice for all procedures in this manual.

Electrical Safety

The instrument is designed to be completely safe when used with options and accessories supplied by the manufacturer for use with the instrument. The instrument is powered by an internally mounted rechargeable battery. The input power supply voltage limits for the battery charger supplied with the instrument are 90 to 264 V AC, 47/63 Hz.

NOTE: No other battery charger unit, other than that supplied with the instrument should be used.

NOTE: Do not allow the battery to fully discharge.

Pressure Safety

DO NOT permit pressures greater than the safe working pressure to be applied to the instrument. The specified safe working pressure is 4350 psig (300 barg). Refer to the Technical Specifications in Appendix A.

Toxic Materials

The use of hazardous materials in the construction of this instrument has been minimized. During normal operation it is not possible for the user to come into contact with any hazardous substance which might be employed in the construction of the instrument. Care should, however, be exercised during maintenance and the disposal of certain parts.

Repair and Maintenance

The instrument must be maintained either by the manufacturer or an accredited service agent. Refer to www.kahn.com for details of Kahn Instruments' worldwide offices contact information.

Calibration

The recommended calibration interval for the Easidew Plus Portable Hygrometer is one year, unless otherwise specified by Kahn Instruments The instrument should be returned to Kahn Instruments.

Abbreviations

The following abbreviations are used in this manual:

AC	alternating current
atm	pressure unit (atmosphere)
barg	pressure unit (=100 kP or 0.987 atm) gauge
°C	degrees Celsius
°F	degrees Fahrenheit
dp	dew point
ft	feet
kg	kilogram
lb	pound
mA	milliampere
m	meter
mm	millimeter
MPa	megapascal
Nl/min	normal liters per minute
psig	pound(s) per square inch (gauge)
scfh	standard cubic feet per hour
µm	micrometer
Ω	ohm
V	Volts

Warnings

The following general warnings listed below are applicable to this instrument. They are repeated in the text in the appropriate locations.

Where this hazard warning symbol appears in the following sections, it is used to indicate areas where potentially hazardous operations need to be carried out.

1 INTRODUCTION

The Easidew Plus Portable Hygrometer comprises a fast responding polymer sensor installed into a sample block with an integrated filter cartridge, and Swagelok® tube fittings on the gas inlet and outlet. The measured dew point from the sensor is shown on the clear red LED display on the front panel of the instrument.

The Easidew Plus Portable Hygrometer can be supplied with either °C or °F dew-point measurement units.

A 4-20 mA analog output is provided for connection to a chart recorder, data-logger or computer system, so dew-point trends can be analyzed over time.

The electronics are housed in a rugged Peli case, providing NEMA 6 protection when the lid is closed. The case is supplied with a lifetime guarantee.

The Easidew Plus Portable Hygrometer is powered by a rechargeable NiMH battery pack, giving between 12 and 16 hours of measurement time from a full charge. The instrument is delivered complete with a universal battery charger stored in the lid. It takes 16 hours to fully charge the battery pack, during which time the instrument can be switched on or off. The charger is suitable to connect power to the instrument indefinitely, but it is recommended to allow the battery pack to go through a full charge-discharge cycle at least once per month. A battery charge indicator on the instrument front panel warns when the battery is low.

Easidew Plus Portable Hygrometer polymer moisture sensors are subject to a 9-point calibration, where their performance is characterized against a fundamental reference hygrometer. This process, and subsequent quality testing, insures that all sensors behave optimally before they are used in the field. Each Easidew Plus Portable Hygrometer is supplied with a calibration certificate traceable to national standards (NIST) from Kahn Instruments.

2 INSTALLATION

On delivery, please check that all the following standard components are present in the packing box:

- Easidew Plus Portable Hygrometer
- Swagelok® 1/4" metering valve
- Swagelok® 1/4" tube port adaptor
- Battery charger
- Power cord
- 3 pole ¼" jack plug (inside lid)
- User manual
- Certificate of calibration
- 0.4mm orifice

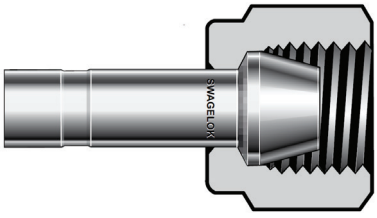
Before using the Easidew Plus Portable Hygrometer for the first time it is recommended that the battery pack is charged for a minimum of 12 hours.

The case has a pressure relief valve on the exterior below the handle. When closed, the case is completely sealed. If the instrument is taken through altitude changes, a pressure differential will occur within the case. If this occurs: **Before opening the lid**, open the black pressure relief valve by one turn (counter-clockwise) for a few seconds. This will equalize the pressures. When the case has been opened, insure that the pressure relief valve has been fully closed.

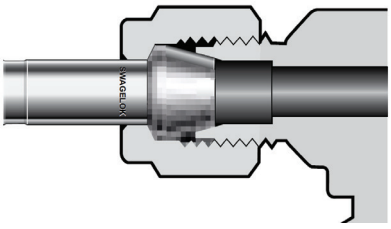
The supplied Swagelok® port adaptor needs to be assembled before the metering valve can be connected to the instrument.

See below:

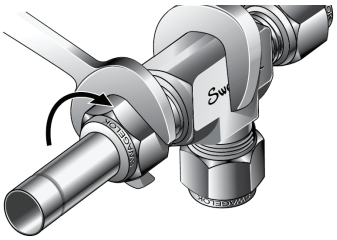
1. Slip the nut over the machined ferrule end of the port connector



2. Insert the port connector into the end connection and finger-tighten the nut



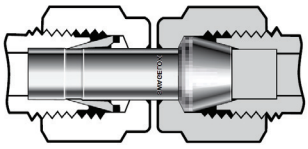
3. While holding the fitting body steady, tighten the nut one-quarter turn



Do not use the Swagelok gap inspection gauge with machined ferrule ends.

NOTE: Connect the machined ferrule end before connecting the tube adapter end

4. Insert the tube adapter until it rests firmly on the shoulder of the Swagelok® tube fitting body. Finger-tighten the nut.



5. Mark the nut at the 6 o'clock position. While holding the fitting body steady, tighten the nut 1¼ turns to the 9 o'clock position.

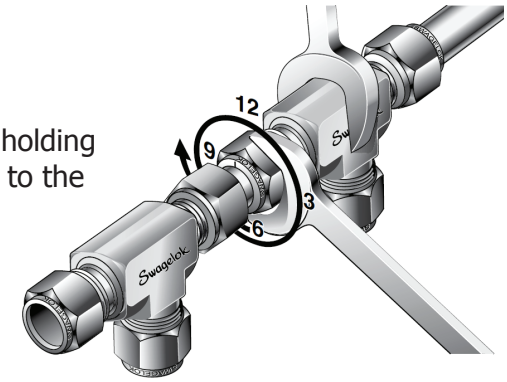


Figure 1 *Swagelok® Fitting Instructions*

3 OPERATION

Maximum operating pressure is 4350 psig (300 barg).

It is important that the gas fittings are correctly tightened, and any tubing is secure in the push fittings before use.

Failure to do so will affect the instrument's pressure rating.

3.1 Instrument Gas Connections

Sample gas connections are made via the Gas in and Gas out ports located on the front of the instrument. Each of these ports is equipped with an adaptor (3) which screws into each gas port.

Two types of adaptors are supplied; a small bore orifice to allow sample gas either in or out of the instrument and two larger bore orifices. Both types of adaptor have a ⅛" NPT internal thread to accommodate the customer's choice of Gas input and Gas output connection fittings.

A range of connection fitting options is available.

Depending upon whether measurements are to be taken at atmospheric pressure or line pressure, the adaptors need to be installed as shown in Figure 1A.

	Readings at atmospheric pressure	Readings at line pressure
System pressures from 15-150 psig (1-10 barg)	Inlet: Small Orifice (#2)	Inlet: Large orifice (#1)
	Outlet: Large Orifice (#1)	Outlet: Small Orifice (#2)
System pressures from 150-350 psig (10 - 300 barg)	Large orifice (#1) Small orifice (#2)	

Figure 1A *Adaptor Fittings*

3.2 General Operation

To operate the Easidew Plus Portable Hygrometer, follow these instructions:

1. Insure that both the gas fittings and the Swagelok® tube fittings are fully tightened before use.
2. For measurement at low pressure or atmospheric pressure, no valving is necessary.
3. For measurement at high pressure (150 psig to 4350 psig / 10-300 bar), connect the supplied metering valve to the outlet of the instrument.
4. Gas under test should be restricted to flow rates 2 and 10 scfh (between 1 and 5 Nl/min) and pressures from atmospheric to 4350 psig (300 barg).
5. Connect the sample gas supply line to the instrument **Gas In** port.
6. Connect the sample gas vent line to the instrument **Gas Out** port.

7. Switch the instrument on. The display will begin to change as the sensor responds to the applied dew point.
8. Allow the gas to flow until the display shows a stable reading. Typically this would be around 15 to 30 minutes for spot checks at dew points of -40°F (-40°C) and above.
9. Switch the unit off and disconnect the sample lines.

Before disconnecting the Easidew Plus Portable Hygrometer from the gas line it is essential to vent the system to atmospheric pressure, otherwise severe injury could result.

NOTE: Filters are essential for potentially dirty/contaminated gases – the installed filter should be checked before and after use and replaced regularly - as required.

3.3 Measuring Dew Points Below -40°F (-40°C)

Due to the significantly lower levels of moisture present at dew points of this level, and the increased amount of time to dry the system out, the response times of the sensor will be significantly increased. The table below offers an approximate guide to the times taken for the instrument to stabilize at a given dew point (from a starting point of 10°Cdp (50°Fdp) ambient):

Target Dew Point		T100 Response Time (mins)
°F	°C	
-22	-30	5
-40	-40	15
-58	-50	30

3.4 User Controls

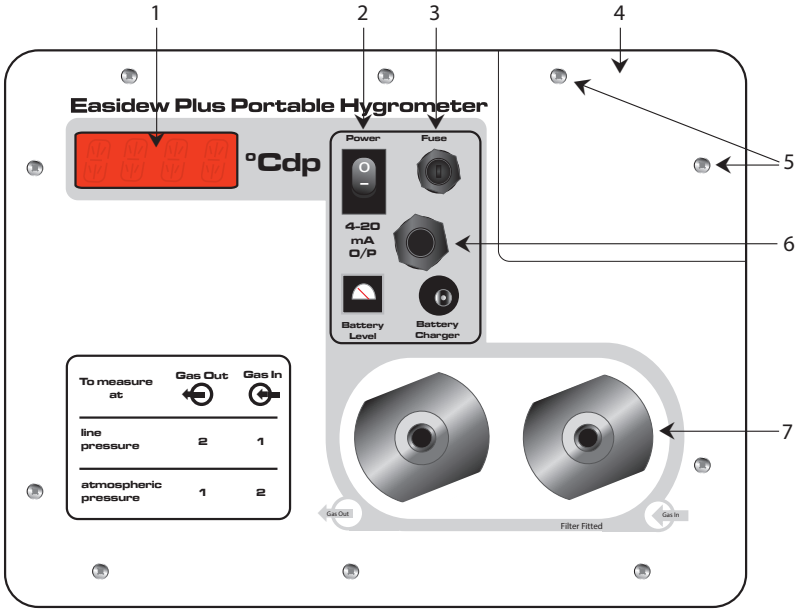


Figure 2 *User Controls*

1	Digital Display	Indicates the measured dew point in °F or °C from -58 to +68°F (-50 to +20°C). Under certain conditions the following error messages may be displayed: **ErrL** = Sensor under range **ErrH** = Sensor over range **Err I** = Sensor fault or sensor disconnected
2	Power Switch	Switches the Easidew Plus Portable Hygrometer ON or OFF.
3	Fuse	This 1A quick blow fuse provides protection for the display electronics in the event of a fault with the charger or battery pack. Another protection fuse is located on the display PCB.
4	NiMH Battery Pack	Located in the top right hand corner of the instrument, it can be accessed by removing two screws (5). The battery pack can be recharged using the supplied charger, via the battery-charging socket and should be recharged whenever the battery level meter is in the red region. See Section 5.6 for troubleshooting information.
		The battery pack will charge if the instrument is switched ON or OFF. However, the battery level meter will only indicate when the instrument is switched on.
6	Analog Output Socket	The Easidew Plus Portable Hygrometer features an analog output socket that provides a linear 4-20 mA current loop, scaled to -76 to +140°F (-60 to +60°C) dew point. This allowed the instrument to be connected to a chart recorder, data logger or PC to enable dew-point trends to be analyzed over time.
7	Gas Fittings	The Easidew Plus Portable Hygrometer can be used for measurements at line pressure (up to 4350 psig (300 barg)) or atmospheric pressure. Swagelok® tube fittings are supplied for use with 1/4" OD stainless steel tube. There is a 32mm particulate filter (99.5% removal of 0.1 micron particles) installed as standard under the **Gas In** port position.

3.5 4–20 mA Output Socket Wiring

The Easidew Plus Portable Hygrometer provides a linear 4-20 mA output scaled from -76 to +140°F (-60 to +60°C).

The socket accepts a 3 pole ¼" jack plug (supplied) and should be wired as shown below:

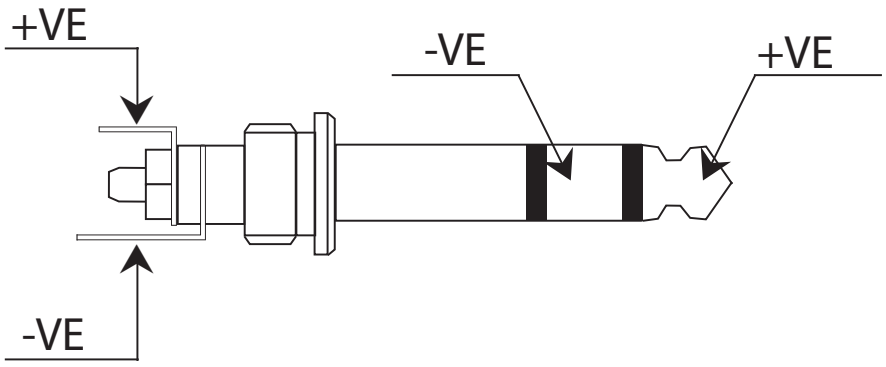
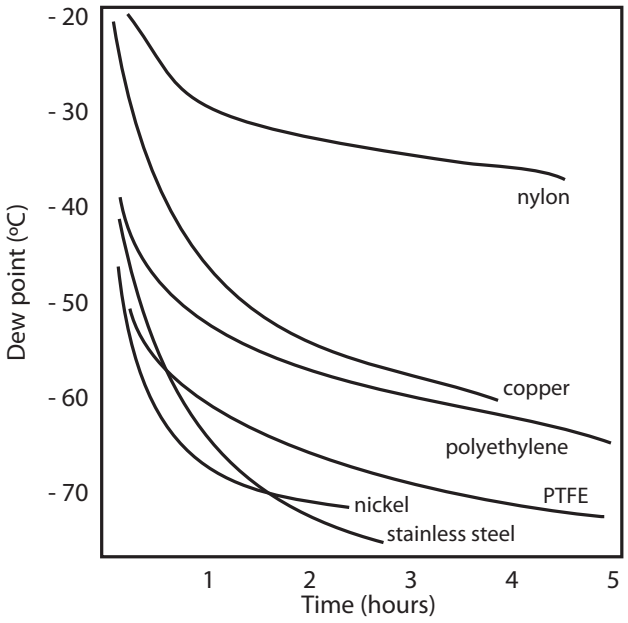


Figure 3 *Jack Plug Wiring*

4 GOOD MEASUREMENT PRACTICE

Measurement of moisture content is a complex subject, but does not need to be difficult. This section aims to explain the common mistakes made in measurement situations, the causes of the problem, and how to avoid them. Mistakes and bad practices can cause the measurement to vary from the expectation; therefore a good sampling technique is crucial for accurate and reliable results.

Transpiration and Sampling Materials



All materials are permeable to water vapor, as the water molecule is extremely small compared to the structure of solids, even when compared to the crystalline structure of metals. The graph to the right shows the dew point inside tubing of different materials when purged with very dry gas, where the exterior of the tubing is in the ambient environment.

Many materials contain moisture as part of their structure, particularly organic materials (natural or synthetic), salts (or anything which contains them) and anything which has small pores. It is important to insure that the materials used are suitable for the application.

If the partial water vapor pressure exerted on the outside of a compressed air line is higher than on the inside, the atmospheric water vapor will naturally push through the porous medium causing water to migrate into the pressurized air line. This effect is called transpiration.

Adsorption and Desorption

Adsorption is the adhesion of atoms, ions, or molecules from a gas, liquid, or dissolved solid to the surface of a material, creating a film. The rate of adsorption is increased at higher pressures and lower temperatures.

Desorption is the release of a substance from or through the surface of a material. In constant environmental conditions, an adsorbed substance will remain on a surface almost indefinitely. However, as the temperature rises, so does the likelihood of desorption occurring.

In practical terms, as the temperature of the environment fluctuates, water molecules are adsorbed and desorbed from the internal surfaces of the sample tubing, causing small fluctuations in the measured dew point.

Sample Tubing Length

The sample point should always be as close to the critical measurement point as possible, in order to obtain a truly representative measurement. The length of the sample line to the sensor or instrument should be as short as possible. Interconnection points and valves trap moisture, so using the simplest sampling arrangement possible will reduce the time it takes for the sample system to dry out when purged with dry gas.

Over a long tubing run, water will inevitably migrate into any line, and the effects of adsorption and desorption will become more apparent. It is clear from the graph shown previously that the best materials to resist transpiration are stainless steel and PTFE.

Trapped Moisture

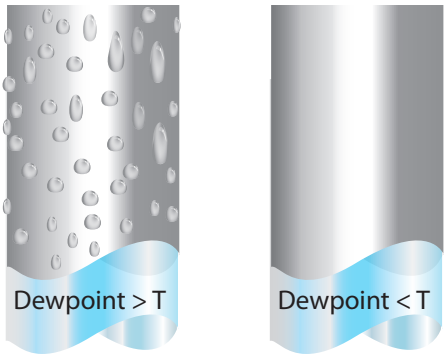
Dead volumes (areas which are not in a direct flow path) in sample lines, hold onto water molecules which are slowly released into the passing gas; this results in increased purge and response times, and wetter than expected readings. Hygroscopic materials in filters, valves (e.g. rubber from pressure regulators) or any other parts of the system can also trap moisture.

Sample Conditioning

Sample conditioning is often necessary to avoid exposure of sensitive measuring components to liquids and other contaminants which may cause damage or affect the accuracy over time, depending on the measurement technology.

Particulate filters are used for removing dirt, rust, scale and any other solids that may be in a sample stream. For protection against liquids, a coalescing filter should be used. The membrane filter is a more expensive but highly effective alternative to a coalescing filter. It provides protection from liquid droplets, and can even stop flow to the analyzer completely when a large slug of liquid is encountered.

Condensation and Leaks



Maintaining the temperature of the sample system tubing above the dew point of the sample is vital to prevent condensation. Any condensation invalidates the sampling process as it changes the water vapor content of the gas being measured. Condensed liquid can alter the humidity elsewhere by dripping or running to other locations where it may re-evaporate.

The integrity of all connections is also an important consideration, especially when sampling low dew points at an elevated pressure. If a small leak occurs in a high pressure line, gas will leak out but vortices at the leak point and a negative vapor pressure differential will also allow water vapor to contaminate the flow.

Flow Rates

Theoretically flow rate has no direct effect on the measured moisture content, but in practice it can have unanticipated effects on response speed and accuracy. The optimal flow rate varies depending on the measurement technology, and can always be found in the instrument or sensor manual.

An inadequate flow rate can:

- Accentuate adsorption and desorption effects on the gas passing through the sampling system.
- Allow pockets of wet gas to remain undisturbed in a complex sampling system, which will then gradually be released into the sample flow.
- Increase the chance of contamination from back diffusion: ambient air that is wetter than the sample can flow from the exhaust back into the system. A longer exhaust (sometimes called a pigtail) can also help alleviate this problem.
- Slow the response of the sensor to changes in moisture content.

An excessively high flow rate can:

- Introduce back pressure, causing slower response times and unpredictable effects on equipment such as humidity generators.
- Result in a reduction in heating capabilities of the sensor tile during the initialization period. This is most apparent with gases that have a high thermal conductivity such as hydrogen and helium.

Which Gases to Measure?

The Easidew Plus Portable Hygrometer is suitable for measurement of the moisture content of a wide variety of gases. In general, if the gas (in conjunction with water vapor) is not corrosive to ceramics or base metals then it will be suitable for measurement.

POSSIBLE INJURY! The tubing, valves and other apparatus attached to this instrument must be adequate for the maximum pressure which will be applied, otherwise physical injury to the operator or bystander is possible.

Before disconnecting the Easidew Plus Portable Hygrometer from the gas line it is essential to vent the system to atmospheric pressure, otherwise severe injury could result.

5 MAINTENANCE

Routine maintenance of the Easidew Plus Portable Hygrometer is confined to regular re-calibration of the internal, removable polymer capacitive sensor and replacement of the filter cartridge.

5.1 Calibration

The calibration of the internal sensor is traceable to national standards. For this reason it should only be calibrated in an accredited, US *National Institute of Standards and Technology* (NIST) standards laboratory. If these facilities do not exist it is recommended that the sensor returned to Kahn Instruments. A calibration certificate bearing a seven-point calibration is issued with each sensor.

In most applications, annual re-calibration insures that the stated accuracy of the Easidew sensor is maintained.

5.2 Sensor / Battery Replacement

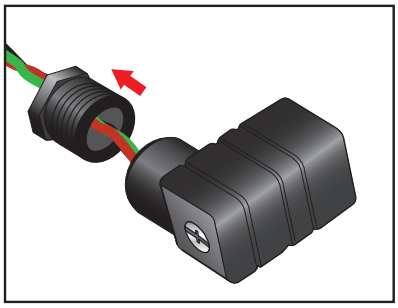
To remove the sensor, or battery pack:

1. Insure that the instrument is switched off and that the battery charger, current output and any sampling components are also disconnected.
2. Remove and retain the 10 Phillips-head screws from the top plate.
3. Lift the small battery pack cover in the top right corner of the instrument. A small flat bladed screwdriver may be required to gently pry the edges of the cover if it has become stuck to the waterproof seal underneath. Removing this cover first will make it easier to lift the entire top panel out of the instrument.
4. Lift the top plate of the instrument out of the case. Disconnect the battery pack before removing the top plate completely to prevent it from straining on the attached cable. If only replacing the battery pack, do not follow the next two steps.
5. Undo the screw from the center of the sensor connecting plug and pull off the connector.
6. Unscrew the sensor from the block.

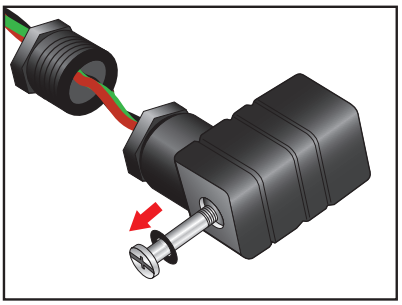
Installing the replacement is simply a reversal of the above procedure. When installing a new sensor it may be necessary to change the alignment of the GDSN connector (see next page).

If the front panel prevents the connector from fitting onto the sensor, follow the instructions below:

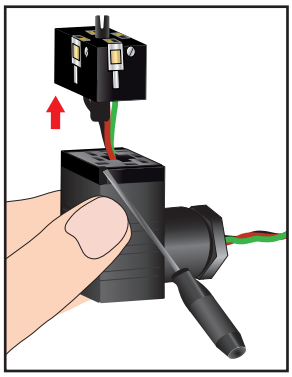
- Completely unscrew the cable gland on the GDSN connector to release the cable tension.



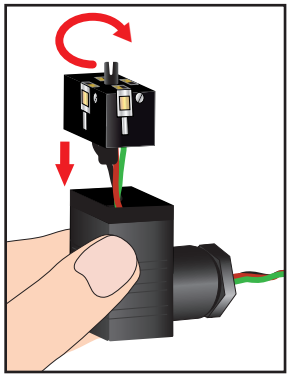
- Remove the locking screw from the back of the connector (retaining the metal O-ring).



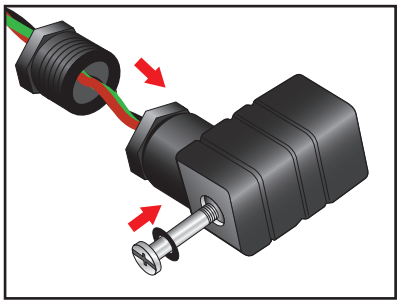
- Remove the connector block using a small screwdriver.



- Rotate the connector block and push it back into the connector housing. Take care not to trap any wires against the hole for the locking screw.



- Replace the locking screw and cable gland.



5.3 Filter Cartridge Replacement

Unscrew the gas inlet fitting to reveal the filter, which can then simply be removed for checking or replacement.

5.4 Checking the Easidew Plus Portable Hygrometer Electronics Calibration

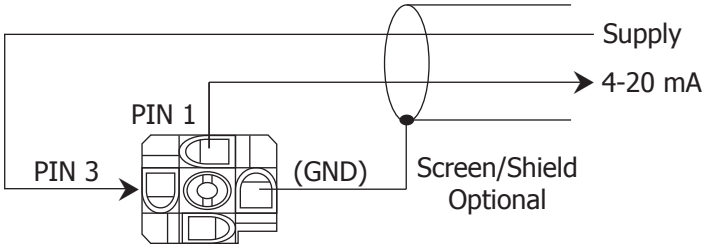


Figure 4 *2-Wire Connection - View Showing Rear of Connector Terminal Block*

To verify if the display electronics are within calibration, a 4-20mA current source can be connected in place of the sensor.

At 4 mA the display should show -60.0°Cdp ±0.5°C (-76.0°Fdp ±0.9°F)

At 20 mA the display should show -76.0°Fdp ±0.9°F (-60.0°Cdp ±0.5°C)

If the displayed values are outside of this range, please contact Kahn Instruments' Service Department.

5.5 List of Spares

P/N	Description
SSF-PF-10PK	Pack of 10 particulate filter cartridges
MDM50-BAT	Replacement battery pack
MDM50-CHR	Replacement battery charger

5.6 Troubleshooting

Symptom	Cause	Actions
Display shows "**Errl**"	Sensor disconnected or sensor element / sensor thermistor fault. **NOTE: This error is normally displayed during the first few seconds while the instrument is starting up.**	Check sensor cable is securely connected inside instrument. Check instrument electronics with 4-20mA source. Exchange sensor.
Display shows "**ErrL**"	Sensor reading under-range. Sensor current signal < 4mA. Sensor element open circuit.	Check instrument electronics with 4-20mA source. Exchange sensor.
Display shows "**ErrH**"	Sensor reading over-range. Sensor current signal > 20mA. Sensor element short circuit.	Sensor may have been exposed to saturation conditions or liquid contamination. Check that filter and sensor guard are clean and dry. If liquid water has contacted sensor, or sensor block, then disassemble and dry thoroughly. After drying, it is recommend to purge assembled instrument with very dry (-103°Fdp (-75°Cdp) / 1ppm$_V$ moisture) air for 12 to 24 hours. Exposure to other contaminants can cause lasting damage and may require sensor to be exchanged. Check instrument electronics with 4-20mA source.
Display flickers on and off	Battery voltage low.	Connect charger.
Display off but battery meter full	Battery voltage low.	Connect charger.

Appendix A

Technical Specifications

Appendix A Technical Specifications

Performance	
Measurement Technology	Polymer Capacitive
Measurement Range	-58 to +68°Fdp (-50 to +20°Cdp)
Accuracy	±3.6°Fdp (±2°Cdp)
Run time	12 - 16 hours
Charge time	16 hours for maximum charge
Flow Rate	2 to 10 scfh (1 to 5 Nl/min)
Electrical Input/Output	
Output	4-20 mA current maximum load resistance 400 Ω
Power Supply	Rechargeable NiMH battery pack, charger included
Operating Conditions	
Operating Temperature	-4 to +122°F (-20 to +50°C)
Storage Temperature	-40 to +167°F (-40 to +75°C)
Operating Pressure	Up to 4350 psig (300 barg)
Mechanical Specifications	
Display	Flush mounted 3.5 digit red LED
Case	Yellow propylene with charger, sample tubing and output connector stored in the lid
Weight	8.8lbs (4kg) total weight
Enclosure Rating Case Closed	NEMA Type 6
Sample Connections	1/4" Swagelok® compression fittings
Sample Block	Stainless steel, fully self-contained sample system using a standard drop-in cartridge
Filter Cartridge	Removes 99.5% of particles ≥ 0.3 µm supplied with cartridge installed. Spare cartridges are available (part no: SSF-PF-10PK)

Appendix B

EU Declaration of Conformity

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MICHELL Instruments

Manufacturer: **Michell Instruments Limited**
48 Lancaster Way Business Park
Ely, Cambridgeshire
CB6 3NW. UK.

CE

We declare under our sole responsibility that the product:

MDM50 Hygrometer.

complies with all the essential requirements of the EU directives listed below.

2014/30/EU **EMC Directive**
2011/65/EU **Restriction of Hazardous Substances Directive (RoHS2)**

and has been designed to be in conformance with the relevant sections of the following standards or other normative documents.

EN61326-1:2013	Electrical equipment for measurement, control and laboratory use – EMC requirements –Class B (emissions) and Industrial Locations (immunity).
EN61010-1:2010	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements

Andrew M.V. Stokes, Technical Director

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